The role of boundary conditions in kaleidoscope laser modes

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The complex character of transverse eigenmodes in one-dimensional (1D) unstable cavity lasers has been known for many years [1]. Early collaborations showed that the origin of such fractal (i.e., multiple spatial scale) structure lies in a subtle interplay between small-scale diffraction effects at the mirror edges and successive round-trip magnifications [2]. Kaleidoscope lasers are intuitive generalizations of the classic strip resonator to fully-2D geometries where the feedback mirror has a non-trivial transverse shape, such as a regular polygon [3]. The fundamental mechanism for fractal formation is preserved, but until recently these novel laser designs have remained largely unexplored. We will report on recent advances in our understanding of kaleidoscope lasers, made possible by new semi-analytical techniques. Aspects to be covered include mode patterns (see figure 1), eigenvalue spectra, convergence phenomena, and also the first calculations of fractal dimension for arbitrary cavity parameters.
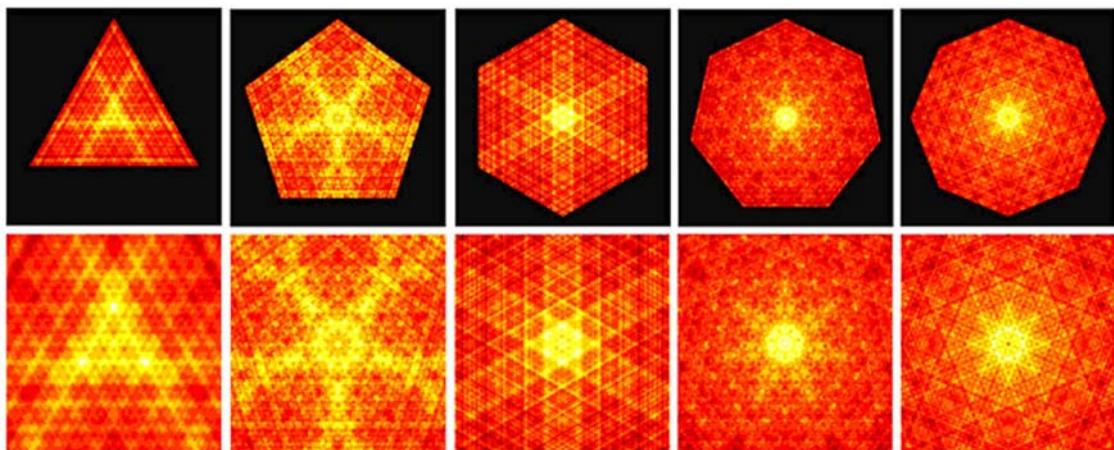

Figure 1. Top row: Computations of the lowest-loss modes for a range of kaleidoscope lasers. Bottom row: magnification of the central portion of each of the corresponding patterns in the top row.

References

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